

# ACTIVE CONTROL OF COMBUSTION INSTABILITIES IN LOW NO<sub>x</sub> GAS TURBINES

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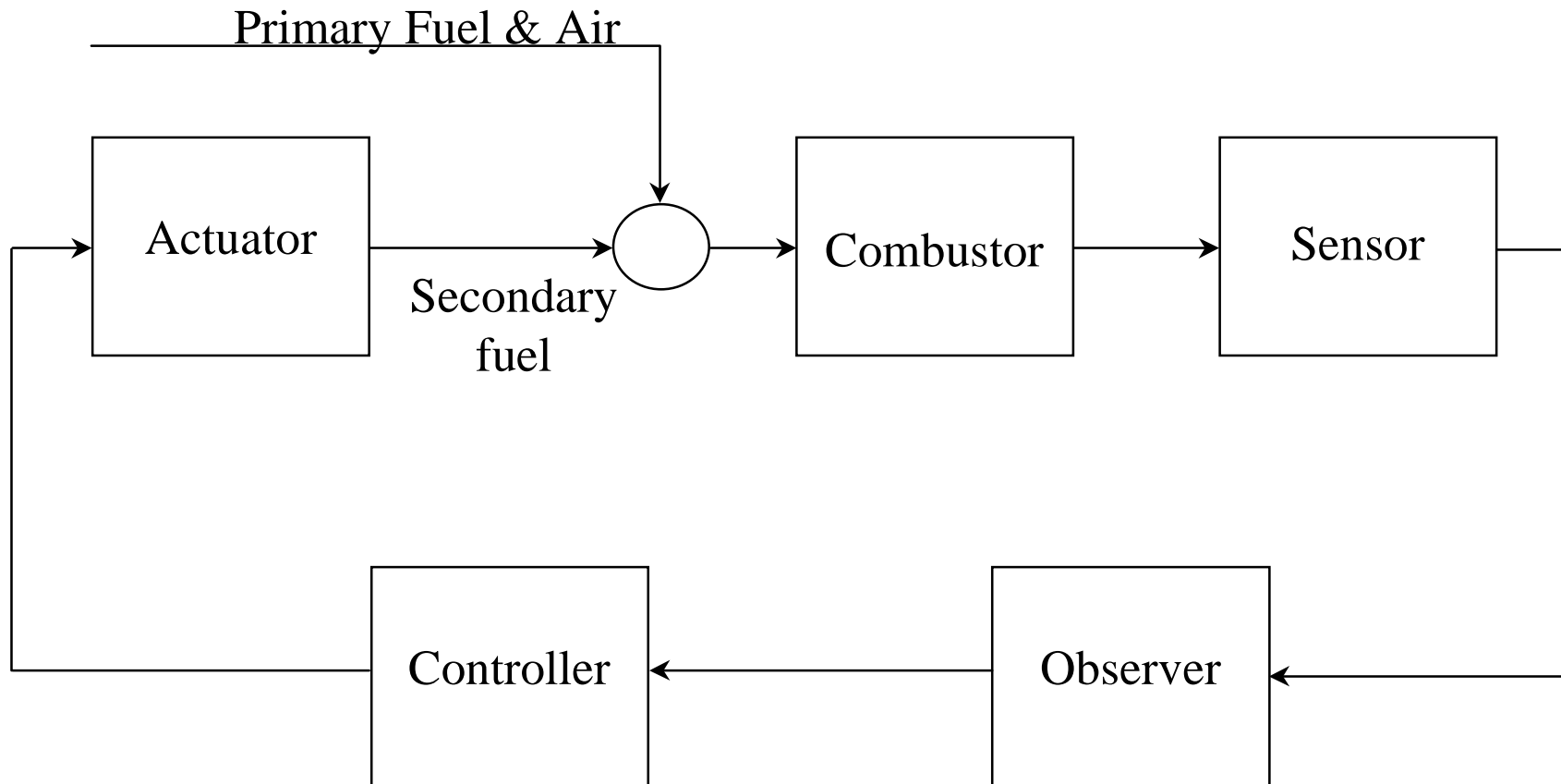


## Program Goals

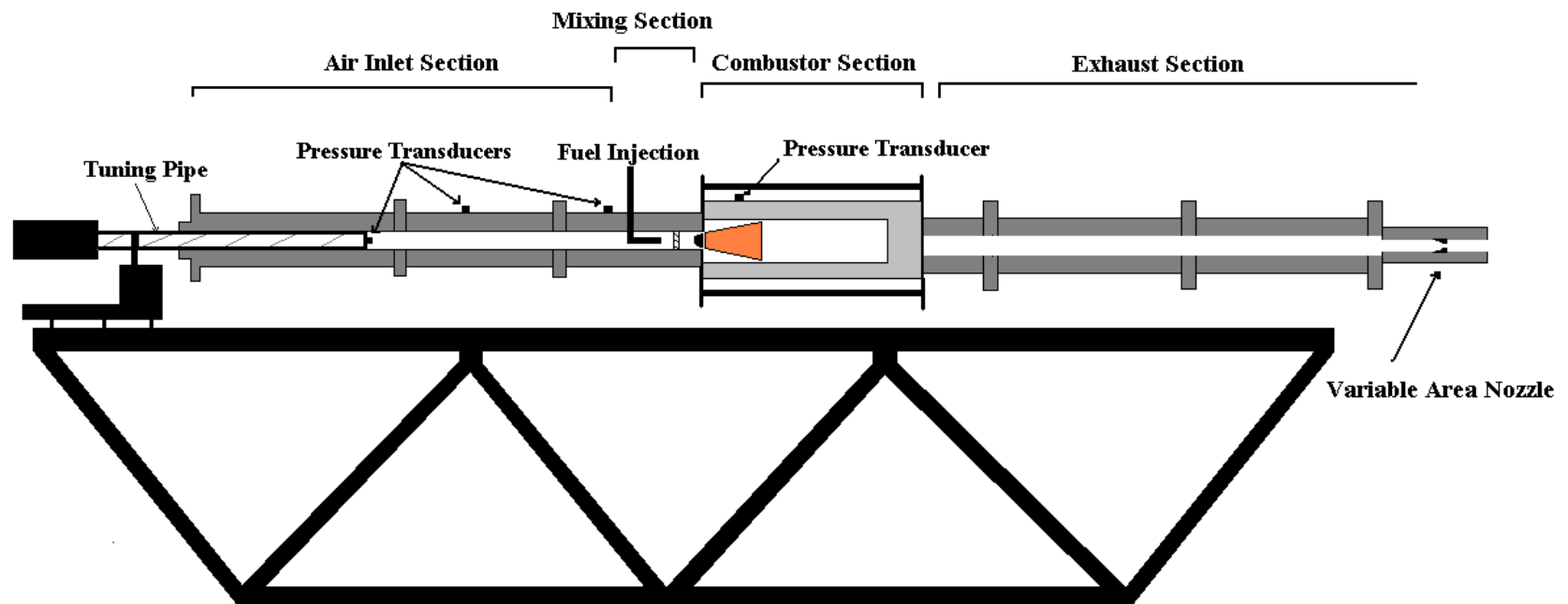
- Investigate mechanisms of combustion instabilities
- Develop and demonstrate adaptive active control system that can rapidly and effectively suppress combustion instabilities
- Disseminate technology to industry



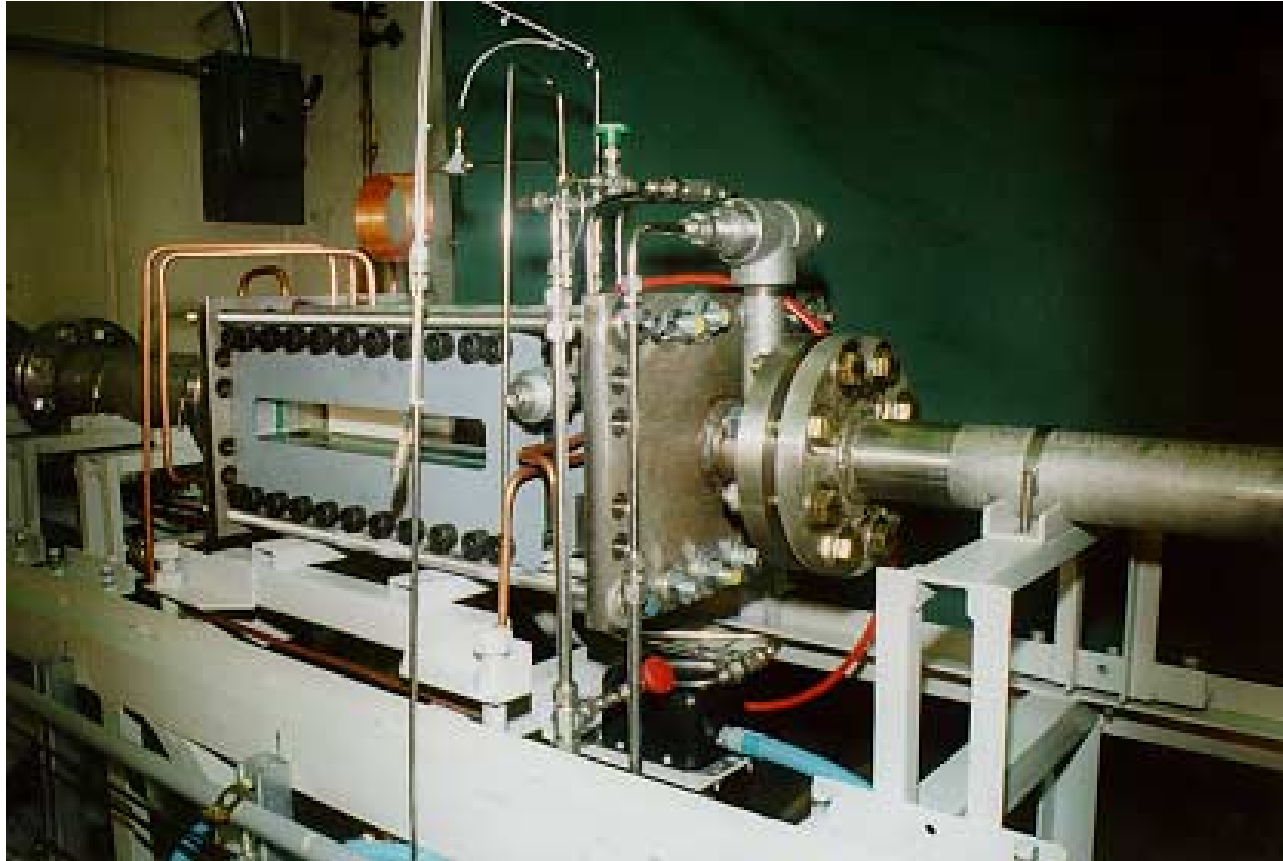
# Developed Active Control



# Georgia Tech LNGT Simulator

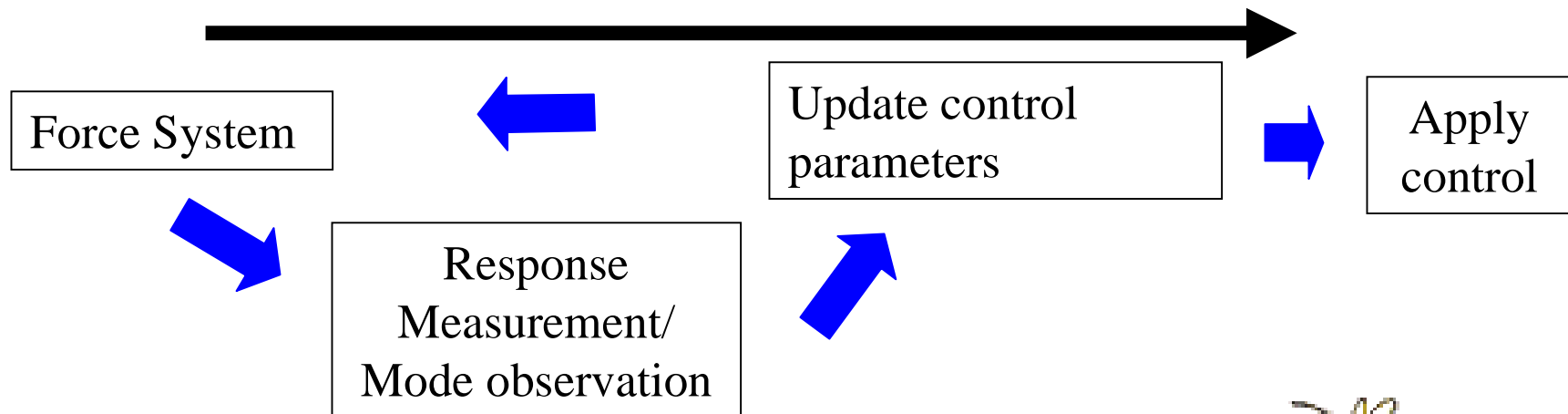


# Georgia Tech LNGT Simulator

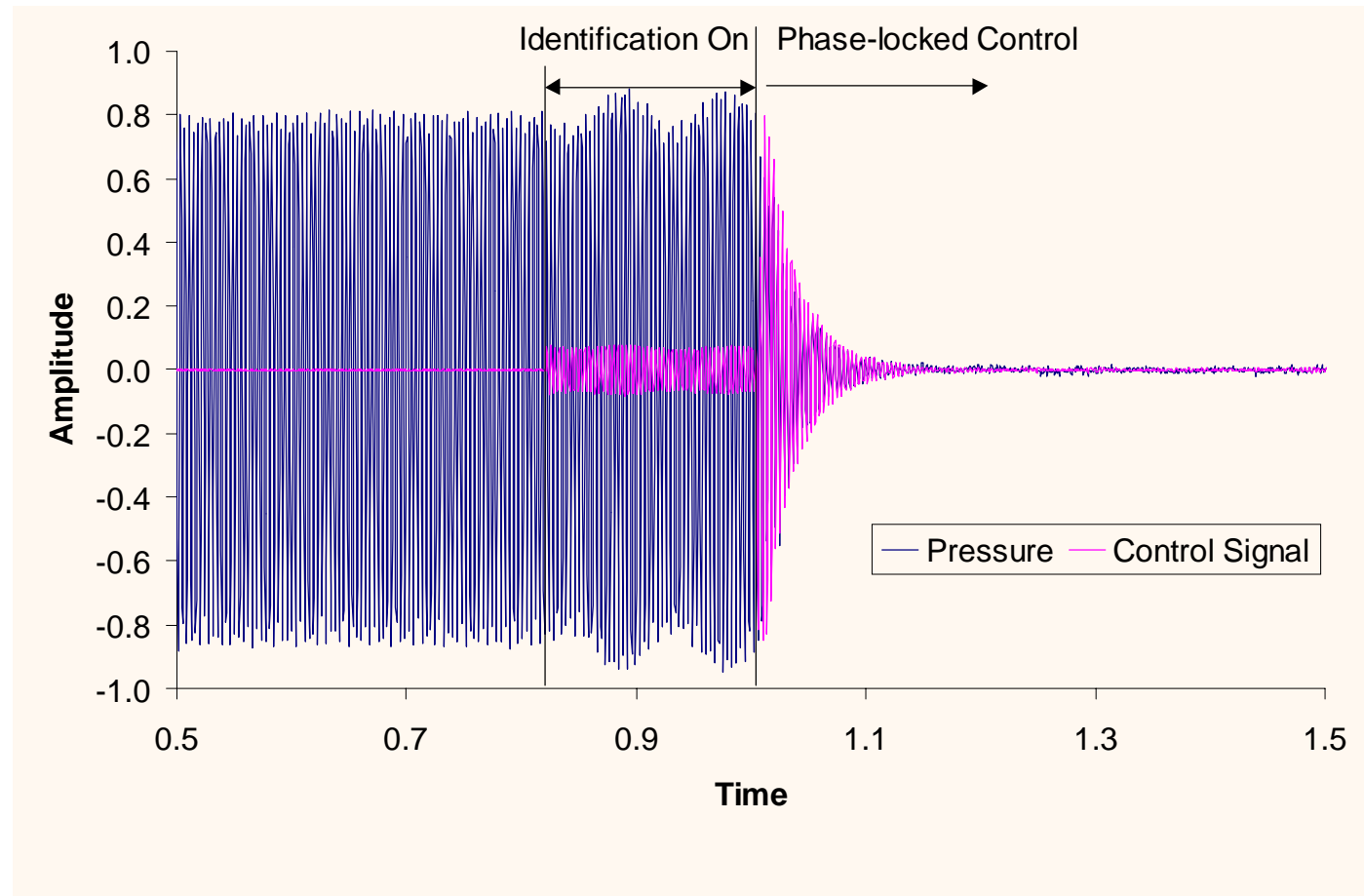


# Adaptive Control of Instabilities

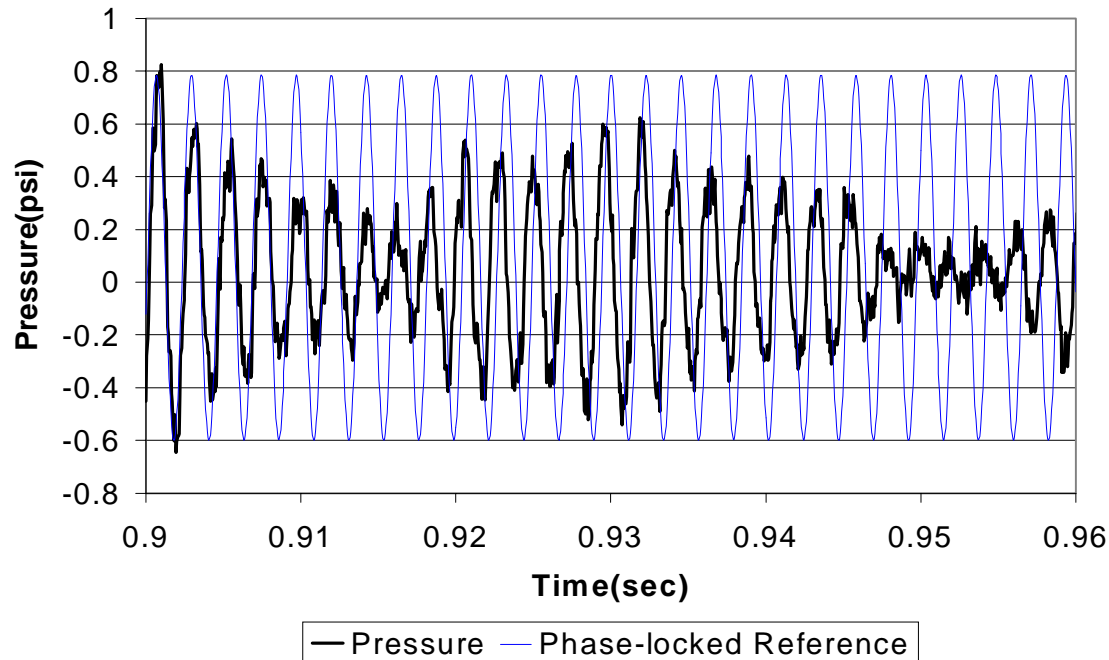
- Methodology:
  - Force the system with a small control signal
  - Correlate system response
  - Apply phase correction to control signal



# Identification and Control: Lean-premixed Combustor



# Background Noise Effects on Phase of Pressure Oscillations

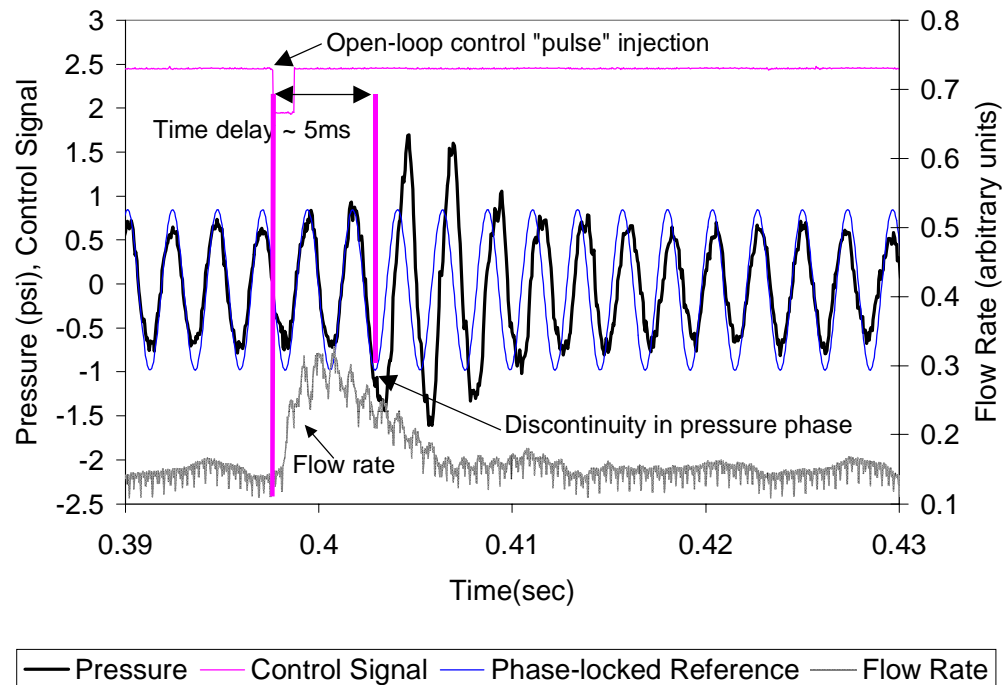


- Phase of pressure oscillations changes rapidly as amplitude of oscillations diminishes





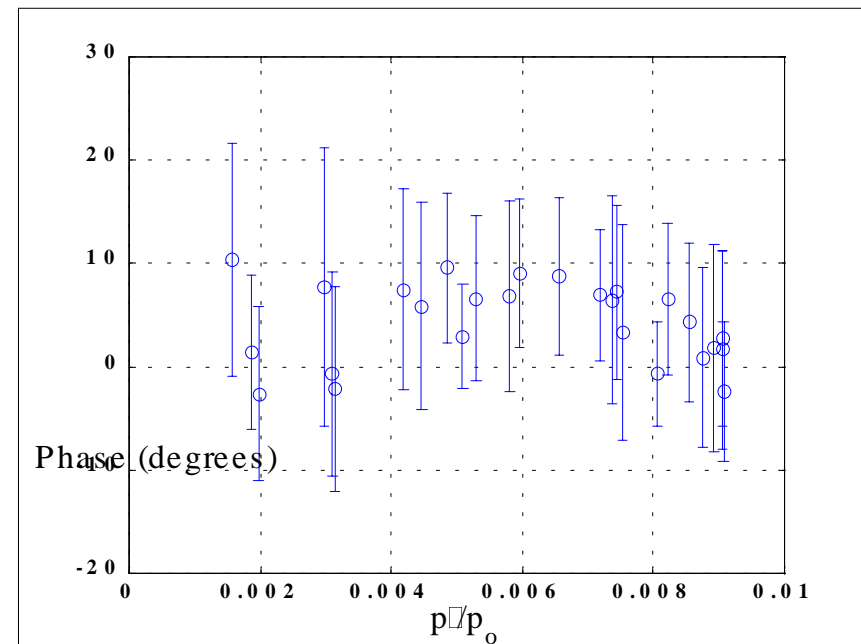
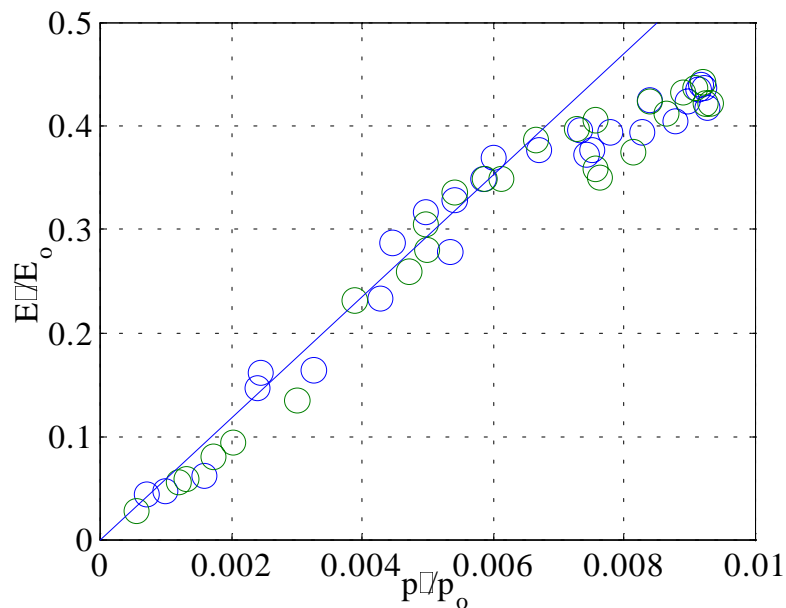
# Time Delay Effects on Controllability



- Combustor pressure phase changes in response to:
  - Ambient background noise
  - active control
- Time delays in system cause uncertainty in phase of oscillations, reducing controllability



# Nonlinear Response of Combustion Process to Perturbations



- Measurements indicate amplitude of heat release oscillations saturates at increased pressure amplitudes



## Program Accomplishments

- Demonstrated up to 15 dB reductions in instability amplitude on both a laboratory combustor and a single can of a full scale gas turbine combustor with the developed adaptive active control system
- Improved understanding of factors limiting effectiveness of active control
- Improved understanding of nonlinear processes responsible for saturating instability amplitude

